



(19) **United States**
(12) **Reissued Patent**
Detering et al.

(10) **Patent Number:** US RE37,853 E
(45) **Date of Reissued Patent:** Sep. 24, 2002

- (54) **FAST QUENCH REACTOR AND METHOD**
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- (21) Appl. No.: **09/569,146**
- (22) Filed: **May 11, 2000**

Related U.S. Patent Documents

Reissue of:

- (64) Patent No.: 5,749,937
 Issued: May 12, 1998
 Appl. No.: 08/404,395
 Filed: Mar. 14, 1995

- (51) **Int. Cl.**⁷ C22B 4/06; C22B 4/08
(52) **U.S. Cl.** 75/10.19; 75/10.21; 75/10.28;
75/346; 266/182; 373/18; 420/590; 422/207;
423/289; 423/613; 585/538
(58) **Field of Search** 75/10.19, 10.21,
75/10.28, 346, 620; 266/182; 219/121.36;
373/18; 420/590; 423/289, 613; 422/207;
585/538, 539

(56) **References Cited**

U.S. PATENT DOCUMENTS

- | | | | | |
|-----------|-----|---------|----------------------|----------|
| 3,051,639 | A * | 8/1962 | Anderson | 585/539 |
| 3,211,548 | A | 10/1965 | Scheller et al. | 75/84 |
| 3,429,691 | A | 2/1969 | McLaughlin | 75/10 |
| 3,630,718 | A | 12/1971 | Newenschwander | 75/0.5 |
| 3,738,824 | A | 6/1973 | Davis et al. | 75/0.5 B |
| 3,840,750 | A | 10/1974 | Davis et al. | 250/547 |
| 3,914,573 | A | 10/1975 | Muehlberger | 219/76 |
| 3,954,954 | A | 5/1976 | Davis et al. | 423/492 |
| 4,022,872 | A | 5/1977 | Carson et al. | 429/297 |
| 4,080,194 | A | 3/1978 | Fey | 75/10 R |
| 4,107,445 | A | 8/1978 | Wolf et al. | 13/2 P |
| 4,145,403 | A * | 3/1979 | Fey et al. | 423/613 |
| 4,164,553 | A | 8/1979 | Perugini et al. | 423/440 |
| 4,335,080 | A | 6/1982 | Davis et al. | 422/244 |
| 4,347,060 | A | 8/1982 | Blizzard et al. | 23/294 R |

- | | | | | |
|-----------|---|-----------|--------------------------|------------|
| 4,356,029 | A | 10/1982 | Down et al. | 75/0.5 B |
| 4,410,358 | A | 10/1983 | Heshmatpour | 75/10.1R |
| 4,561,883 | A | * 12/1985 | Mullner et al. | 75/10.19 |
| 4,610,718 | A | 9/1986 | Araya et al. | 75/0.5 C |
| 4,731,111 | A | 3/1988 | Kopatz et al. | 75/0.5 AB |
| 4,762,756 | A | 8/1988 | Bergmann et al. | 428/698 |
| 4,772,315 | A | 9/1988 | Johnson et al. | 75/0.5 A |
| 4,783,216 | A | 11/1988 | Kemp et al. | 75/0.5 BB |
| 4,801,435 | A | 1/1989 | Jozef | 422/186.04 |
| 4,875,810 | A | 10/1989 | Chiba et al. | 406/1.14 |
| 4,891,066 | A | 1/1990 | Shimotori et al. | 75/84 |
| 4,909,914 | A | 3/1990 | Chiba et al. | 204/164 |
| 4,911,805 | A | 3/1990 | Kenji et al. | 204/164 |
| 5,017,754 | A | 5/1991 | Drouet et al. | 219/121.36 |
| 5,028,417 | A | 7/1991 | Gulghuji et al. | 424/59 |
| 5,062,936 | A | 11/1991 | Beaty et al. | 204/164 |
| 5,073,193 | A | * 12/1991 | Chaklader et al. | 75/346 |
| 5,194,128 | A | 3/1993 | Beaty et al. | 204/164 |
| 5,215,749 | A | * 6/1993 | Nicoll et al. | 424/401 |
| 5,257,500 | A | 11/1993 | Kattalaicheri et al. ... | 60/39.821 |
| 5,294,242 | A | 3/1994 | Zurecki et al. | 75/345 |
| 5,935,293 | A | * 8/1999 | Deterring et al. | 75/10.19 |

OTHER PUBLICATIONS

Down, M. G., *Titanium Production by a Plasma Process*, Final Technical Report, Materials Laboratory, Air Force Wright Aeronautical Laboratories (#AD A 121892) May 1982, pp. 1-8.

"The INEL Plasma Research Program", Idaho National Engineering Laboratory (BP422E-R0592-1M-T), May 1992.

* cited by examiner

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(57) **ABSTRACT**

A fast quench reaction includes a reactor chamber having a high temperature heating means such as a plasma torch at its inlet and a restrictive convergent-divergent nozzle at its outlet end. Reactants are injected into the reactor chamber. The resulting heated gaseous stream is then rapidly cooled by passage through the nozzle. This "freezes" the desired end product(s) in the heated equilibrium reaction stage.

70 Claims, 7 Drawing Sheets

